IN MEMORY OF.....

JOSEPH JOHN MACKNIS

This 7th Annual Meeting of the Maryland Water Monitoring Council is dedicated to the memory of Joe Macknis, 54, who died on July 1, 2001. Joe, an environmental scientist known to many in the water monitoring world, was on the staff at EPA's Chesapeake Bay Program office in Eastport, MD. He was also a regular attendee at the MWMC annual meetings and addressed the Board of Directors at least once on monitoring-related activities at the Bay Program.

Born in Mahoney City, PA, Joe earned an undergraduate degree from Bloomsburg State College in Bloomsburg, PA, and a master's degree in environmental policy from the University of Delaware. He joined the Bay Program staff in the late 1970's and enthusiastically embraced the opportunity to apply his interests in linking policy and science. Joe's work with the Bay Program was key to discovering the connections between the decline of Chesapeake Bay and the main culprits: nitrogen and phosphorous. His focus on point-source nutrients provided the leadership that lead to two significant achievements: a ban on the use of phosphate detergents and the promotion of biological nutrient removal (or BNR) at sewage treatment plants.

Kent Mountford, a colleague and former senior scientist at the Bay Program had these words to say about Joe. "He was a remarkably tenacious, thorough worker. He had energy and enthusiasm. He assembled the source of the contaminants and brought the issue to a head. He argued that the largest source of contaminants was the nutrients – nitrogen and phosphorous - coming from municipal waste water, agricultural runoff and the atmosphere – not so much from the industrial toxins. All of us who knew and loved him lost a solid and supportive friend. His legacy of hard work, loyalty and perseverance inspires all of us who plan for the Bay's future."

Ron Klauda

PROGRAM COMMITTEE

Carl Weber (Chair)	*University of Maryland Baltimore County*
Tony Allred	*Maryland Department of Natural Resources*
Ken Belt	*USDA Forest Service, Baltimore Ecosystem Study*
Christine Buckley	*Harford County Department of Public Works*
Brian Clevenger	*Maryland Department of the Environment*
Ron Klauda	*Maryland Department of Natural Resources*
Paul Miller	*Maryland Department of Natural Resources*
Bill Stack	*Baltimore City Water Quality Management Office*
Steve Stewart	*Baltimore County Department of Environmental Protection and Resource Management*

Thought for the Day

"The hydrological cycle is indeed massive with hundreds of thousands of cubic kilometers of water exchanged every year between the atmosphere, oceans, and landmasses. But it is a very sensitive, complicated and fragile system, particularly relative to human needs. Only about three-tenths of one percent of all water on the globe is fresh and found in river and lake sources."

-Rafael Bras
1998 Clarke Prize Laureate

MARYLAND WATER MONITORING COUNCIL

W E L C O M E

7th Annual Meeting
Maryland Water Monitoring Council

16 November 2001
Maritime Institute of Technology and Conference Center
5700 Hammonds Ferry Road
Linthicum Heights, MD 21090

The Maryland Water Monitoring Council's 7th Annual Meeting will provide a forum for people involved or interested in water monitoring activities and an opportunity for them to meet and talk to others with similar interests from federal, state, or local government agencies and citizen monitoring groups. The theme of this year's meeting is ***Scale Matters***. Speakers and posters will discuss water monitoring, assessment and regulatory activities in the context of different spatial scales. The conference program will include presentations on how water resources managers are making adjustments and accommodations for scale differences ranging from small sub-watersheds of only a few square miles to the entire Chesapeake Bay basin.

To find out more about the Maryland Water Monitoring Council, please go to:
http://www.mgs.md.gov/mwmc

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Maryland Water Monitoring Council
7th Annual Meeting
16 November 2001

Meeting Theme: *Scale Matters*

PROGRAM AT A GLANCE

8:00 - 9:00 am	Registration, Continental Breakfast and Poster/Vendor Set-up
	Plenary Session - Auditorium
9:00 - 9:5 am	Welcome and Introductions - *Emery Cleaves*
9:15 - 9:45 am	Keynote Address - *Larry Band*
9:45 - 10:15 am	Defining Restored Chesapeake Bay Water Quality from the Fish, Crabs, Oysters and Grasses Perspective - *Rich Batiuk*
10:15 - 10:45 am	**Coffee Break and Poster/Vendor Session**
10:45 - 11:15 am	Sediment and Scale in the Chesapeake Bay - *Michael Langland*
11:15 - 11:45 am	Implications of Scale and Watershed Size for Management Approaches: An Example Related to Biocriteria - *Rich Eskin*
12:00 - 1:00 pm	**Lunch and Poster/Vendor Session**

CONCURRENT BREAKOUT SESSIONS (A, B, C, D)

Bridge Room	Room A300
1:00 - 2:30p.m. Integrating State-Local Monitoring Programs (A) • Integration of State and Local Government Monitoring and Assessment Programs • Maryland Stream Waders: An Innovative Statewide Volunteer Stream Monitoring Program • Method Performance Characteristics and the Merging of Biological Assessment Data Sets	1:00 - 2:30 p.m. Urban Infrastructure Effects on Hydrology (B) • Issues, Challenges and Prospects of Water Resources Infrastructure in Urban Ecosystems • Channel Protection • Evaluation of Stream Impacts from Leaking Infrastructure in the Lower Gwynns Falls Watershed • Relating Instream Biological Condition to BMP Activities in Streams and Watersheds
2:30 - 3:00 p.m.	Break and Poster/Vendor Session
3:00 - 4:30 p.m. Small Watersheds: Form, Function and Future (C) • Nitrogen Fluxes in Urban Riparian Zones • Nutrient Discharges from Watersheds Covering a Few Hectares to Hundreds of Square Kilometers • Influence of Watershed Morphology and Sediment Biogeochemistry on Nitrate Fluxes to Streams • Application and Extension of TOPMODEL Concepts to Hydrochemical Processes in Small Watersheds	3:00 - 4:30 p.m. Use of GIS in Water Resource Management (D) • Using Online GIS as a Water Quality Monitoring Tool • Impervious Surface Mapping of the Chesapeake Bay Watershed • The Herring Run Watershed Association 2000-2001 Water Quality Program
4:30 p.m.	Adjourn (See you next year!)

Maryland Water Monitoring Council
7th Annual Meeting
16 November 2001

Meeting Theme: *Scale Matters*

DETAILED PROGRAM

8:00 - 9:00 am	Registration, Continental Breakfast and Poster/Vendor Set-up
	Plenary Session - Auditorium
9:00 - 9:15 am	Welcome and Introductions - *Emery Cleaves,* Maryland Geological Survey*,* Chairman of MWMC Board of Directors
9:15 - 9:45 am	Keynote Address - *Larry Band*, University of North Carolina at Chapel Hill will discuss **Watersheds, Ecosystems and Us: The Baltimore Ecosystem Study**
9:45 - 10:15 am	**Defining Restored Chesapeake Bay Water Quality from the Fish, Crabs, Oysters and Grasses Perspective** - *Rich Batiuk*, U.S. Environmental Protection Agency
10:15 - 10:45 am	**Coffee Break and Poster/Vendor Session**
10:45 - 11:15 am	**Sediment and Scale in the Chesapeake Bay** - *Michael Langland*, U.S. Geological Survey
11:15 - 11:45 am	**Implications of Scale and Watershed Size for Management Approaches: An Example Related to Biocriteria** - *Rich Eskin*, Maryland Department of the Environment
12:00 - 1:00 pm	**Lunch and Poster/Vendor Session**

Concurrent Breakout Sessions

(speaker is underlined)

The afternoon portion of this meeting is comprised of four, 90 minute technical sessions-two before the break and two after.

Breakout Session A - Bridge Room

1:00 - 2:30 pm **State-Local Integration of Monitoring Programs**

Session Coordinators: *Ron Klauda*, Maryland Department of Natural Resources and *Bob Shedlock*, U.S. Geological Survey - organized by the Monitoring and Assessment Committee

Integration of State and County Stream Monitoring Programs. *Nancy Roth*, *Jon Volstad, Ginny Mercurio* and *Mark Southerland*, Versar, Inc.; *Ron Klauda* and *Paul Kazyak*, Maryland Department of Natural Resources; *Keith Van Ness*, Montgomery County Department of Environmental Protection; and *Wayne Davis*, U.S. Environmental Protection Agency

Maryland Stream Waders: An Innovative Statewide Volunteer Stream Monitoring Program. *Dan Boward* and *Rita Bruckler*, Maryland Department of Natural Resources

Method Performance Characteristics and the Merging of Biological Assessment Data Sets. *James B. Stribling*, Tetra Tech, Inc.

Breakout Session B - Room A300

1:00 - 2:30 pm **Urban Infrastructure Impacts on Hydrology**

Session Coordinators: *Ken Belt*, USDA Forest Service/BES and *Bill Stack,* Baltimore City Water Quality Management Office - organized by the Programmatic Coordination Committee

Issues, Challenges and Prospects of Water Resources Infrastructure in Urban Ecosystems. *Lawrence E. Band* and *Neely L. Law*, University of North Carolina at Chapel Hill

Channel Protection. *Ted Brown* and *Deb Caraco*, Center for Watershed Protection

Evaluation of Stream Impacts from Leaking Infrastructure in the Lower Gwynns Falls Watershed. *Gary T. Fisher*, U.S. Geological Survey and *Bill Stack*, Baltimore City Water Quality Management Office

Relating Instream Biological Condition to BMP Activities in Streams and Watersheds. *James. B. Stribling* and *Erik W. Leppo*, Tetra Tech, Inc.; *James D. Cummins*, Interstate Commission on the Potomac River Basin; *John Galli*, Metropolitan Washington Council of Governments; *Sharon Meigs, Larry Coffman* and *Mow-Soung Cheng,* Prince Georges County Department of Environmental Resources

2:30 - 3:00 pm **Break and Poster/Vendor Session**

Breakout Session C - Bridge Room

3:00 - 4:30 pm **Small Watersheds: Form, Function and Future**

Session Coordinator: *Ken Belt,* USDA Forest Service/Baltimore Ecosystem Study

Nitrogen Fluxes in Urban Riparian Zones. *Peter M. Groffman,* Institute of Ecosystem Studies

Nitrogen Discharges from Watersheds Covering a Few Hectares to Hundreds of Square Kilometers. *Thomas E. Jordan, Donald E. Weller* and *David L. Correll,* Smithsonian Environmental Research Center

Influence of Watershed Morphology and Sediment Biogeochemistry on Nitrate Fluxes to Streams. *Karen Prestegaard*, University of Maryland

Application and Extension of TOPMODEL Concepts to Hydrochemical Processes in Small Watersheds. *Jeff Raffensperger*, U.S. Geological Survey

Breakout Session D - Room A300

3:00 - 4:30 pm **Use of GIS in Water Resources Management**

Session Coordinator: *Tony Allred,* Maryland Department of Natural Resources - organized by the Data Management Committee

Using Online GIS as a Water Quality Monitoring Tool. *Ken Miller,* Maryland Department of Natural Resources

Impervious Surface Mapping of the Chespeake Bay Watershed. *John Morgan III*, Towson University

The Herring Run Watershed Association 2000-2001 Water Quality Program. *Dan Dillon*, Herring Run Watershed Association

4:30 pm **Adjourn** (see you next year)

7th Annual Meeting
Maryland Water Monitoring Council
16 November 2001

SCALE MATTERS

PLENARY, CONCURRENT AND POSTER SESSION ABSTRACTS

(alphabetical by lead author)

Integrating Biological Monitoring Data from Potomac Nontidal Rivers and Streams Using a Relational Database

LeAnne Astin, Interstate Commission on the Potomac River Basin, Rockville, MD

ABSTRACT: Research on the nontidal Potomac ecosystem is hampered by data that exists in varied forms and cannot easily be compared. The objective of the Interstate Commission on the Potomac River Basin (ICPRB) Basinwide Assessments program is to improve understanding of the biotic integrity of the Potomac watershed by combining data from separate monitoring surveys by the Basin's member jurisdictions (Maryland, Pennsylvania, Virginia, West Virginia and the District of Columbia) with available contextual information. To this end, ICPRB is improving a relational database management system (RDBMS) for integrating biological monitoring data from nontidal rivers and streams. However, as noted by Barbour et al. (1999),"[t]he ability to combine unlike datasets has historically been a problem for scientific investigations." While states' biological monitoring data cannot be compared directly, most apply a similar approach to data analysis.

This approach requires a stream classification framework to partition natural variability into relatively homogenous groups. As few Potomac streams remain pristine, different jurisdictions apply different criteria to select reference sites and make comparisons. ICPRB is adapting the classification framework to resolve these differences. Consistent criteria from state assessments have been selected and their scores converted to a common scale. A simple clustering approach is being used to group and classify like sites. Alternative classification schemes using select landscape features (ecoregion, catchment, land use, stream order) are also being explored. Sites classified under these criteria will be used to define reference communities against which organism assemblages can be compared.

Additional monitoring data will continue to be integrated into the relational database in order to validate the framework, generate evaluations and examine relationships and trends among physical, chemical and biological components. Ultimately the database will store existing assessments and historical datasets within a single data repository and in a consistent format, integrate and analyze primary biomonitoring data, generate indicators and evaluations and make the results accessible to researchers and the general public via the World Wide Web.

Issues, Challenges and Prospects of Water Resources Infrastructure in Urban Ecosystems

Lawrence E. Band and *Neely L. Law*, University of North Carolina at Chapel Hill

ABSTRACT: A workshop was organized by the Baltimore Ecosystem Study (BES) in June 1999 to explore the role of water resources infrastructure on rural-urban ecosystem function. Many of the critical interactions between human society and ecosystems are mediated by the form, extent and function of water-related infrastructure that develops over decades to centuries as part of the evolution of urban space. The term 'infrastructure' was broadly defined to include more than structural interventions of the natural system and encompasses the physical, ecological and societal aspects of water resource management system. The development and functioning of urban water resources infrastructure include feedback loops between watershed and ecosystem conditions, economic demand, human perception of the environment, and the regulatory and management response to individual, community and institutional needs. Workshop discussions highlighted the need for an integrated conceptual framework to address water resources infrastructure but acknowledged the challenges such a framework presents. Key recommendations addressed: identification, measurement and modeling of hydrologic connectivity; spatial and temporal scaling of processes; and definition of an interdisciplinary paradigm that reflects the multiple dimensions of water resources infrastructure in urban ecosystems.

Watersheds, Ecosystems and Us: The Baltimore Ecosystem Study

Lawrence E. Band, University of North Carolina-Chapel Hill; *Ken Belt*, U.S. Forest Service/Baltimore Ecosystem Study; *Peter Groffman*, Institute of Ecosystem Studies;
Gary Fisher, U.S. Geological Survey, Baltimore, MD, *Neely Law*, University of North Carolina-Chapel Hill; *David Tenenbaum*, University of North Carolina-Chapel Hill; *Ed Doheny*, U.S. Geological Survey

ABSTRACT: The Baltimore Ecosystem Study (BES) is one of 24 Long Term Ecological Research Projects (LTER) funded and coordinated by the National Science Foundation. Central objectives of the LTER network are to quantify and explain the interactions between carbon, nutrient and water cycles and the dominant ecological communities within a range of biomes. Of the 24 sites, two are located in urban areas- the BES and the Central Arizona Project (CAP), in Phoenix. In urban areas, we (human society) represent the dominant ecological community, such that our individual and institutional behavior and dynamics are key to the state and function of the urban ecosystem. Alteration of land cover/land use, inputs and outputs of material, and the extent and character of the drainage network by successive generations significantly alter the cycling and transport of water, carbon and nutrients.
A primary goal of our work is to determine how individual and institutional behavior interacts with basic biophysical processes within the urban ecosystem, and how new ecological knowledge can be used by communities to improve their environment and quality of life. In the Baltimore context, this includes managing our landscapes to reduce nutrient export to the Chesapeake Bay. As part of the BES we have initiated long term monitoring of a nested set of watersheds with both small headwater and larger catchments in different distinct land uses, arranged along the mainstream of the Gwynns Falls in a rural to urban gradient. Basic data collection includes continuous stream gauging, distributed meteorology, weekly stream chemistry, permanent plot hydrology and biogeochemistry, as well as repeated social and population ecological surveys. Most of the data is currently focused on the Gwynns Falls and Oregon Ridge (Baismans Run and Pond Branch) watersheds, with data collection beginning in the Fall of 1998. However, this data is augmented by a longer and more widely distributed set of observations in the region collected by municipal, state, and federal agencies, nonprofit organizations as well as other academic researchers.

Rapid expansion of cities into the surrounding countryside in the last few decades has created urban spaces that are intricate mixes of residual agricultural and forested areas as part of the urban matrix. The juxtaposition of these land covers, and the rapid conversion of the landscape produces strongly varying water and material flux, with large impacts on stream form and watershed export. Comparison of urban with predominantly agricultural and forest catchments provides us with both a set of contrasting environments as well as important land use components and precedents of the larger urbanizing environment. Widely varying ages of settlement and redevelopment produce a range of residential land cover patterns and water infrastructure, such that we see large variations in the hydrology and biogeochemistry of sub-watersheds within similar land use classes. In addition to long term monitoring, we are setting up linked spatial data and process modeling systems within a framework that can integrate human and natural dynamics. These data and modeling systems serve as tools to support research and potentially, decision making. However they also provide formalizations of our integrative urban watershed paradigm. The paradigm merges an ecological patch dynamic theory with a nested and cumulative watershed impact approach. In this presentation we will describe the theoretical framework for our approaches, and provide illustrations from our monitoring and spatial modeling.

Defining Restored Chesapeake Bay Water Quality from the Fish, Crabs, Oysters and Grasses Perspective

Rich Batiuk, U.S. Environmental Protection Agency, Chesapeake Bay Program, Annapolis, MD

ABSTRACT: A centerpiece of the Chesapeake 2000 Agreement was the 2010 goal to restore Bay water quality to the point where the Chesapeake and its tidal rivers can be removed from the list of impaired waters. As a critical step towards that goal, the Bay watershed states have committed to developing and adopting a set of Chesapeake Bay-specific criteria and designated uses as state water quality standards. Dissolved oxygen, water clarity and chlorophyll criteria, along with a set of habitat-based designated uses, are being developed to define restored Bay water quality. How existing tidal water quality compares to these draft criteria and implications for implementation of an expanded tidal monitoring network for the Chesapeake Bay will be presented.

Maryland Stream Waders - An Innovative Statewide Volunteer Stream Monitoring Program

Dan Boward and *Rita Bruckler*, Maryland Department of Natural Resources, Annapolis

ABSTRACT: Maryland Stream Waders is a statewide volunteer stream sampling program managed by Maryland Department of Natural Resources (DNR). Volunteers are recruited and trained by DNR staff. The volunteers collect samples of benthic macroinvertebrates using to Maryland Biological Stream Survey (MBSS) protocols. One goal of the program is to increase the sampling site density (over that of MBSS) by choosing stream sites at a smaller spatial scale. An overview of the program and selected results will be presented, as well as some challenges and successes from the first two years of the program.

Channel Protection

Ted Brown and *Deb Caraco*, Center for Watershed Protection, Ellicott City, MD

ABSTRACT: It is widely accepted that urbanization can alter the geometry and stability of stream channels. Both anecdotal evidence and field research support the notion that the larger and more frequent discharges that accompany watershed development cause downstream channels to enlarge, whether by widening, down-cutting or a combination of both. Channel enlargement severely degrades the quality of instream habitat structure and sharply increases the annual sediment yield from the watershed. These two factors, in turn, are often correlated with the sharp drop in aquatic diversity frequently observed in urban streams . Despite the large body of research available, many questions about the channel enlargement process in urban and suburban streams remain to be answered. For example, how much development can occur before a stream response is observed? Exactly how much will a channel enlarge, and how many years will it take to do so? Finally, what stormwater management strategies can engineers use to mitigate the amount of future channel
enlargement? While it is not easy to predict the absolute degree of channel enlargement caused by watershed development, it is clear that enlargement will occur
in the absence of stormwater controls. Therefore, the challenge facing the engineering community is to develop and adopt stormwater management criteria that will provide adequate channel protection to minimize the extent of future channel enlargement. This paper explores some of the past and current approaches to providing channel protection through stormwater management criteria. The relative effectiveness of the criteria are discussed along with the inherent limitations of the various management approaches.

Plankton Restoration Goals for Chesapeake Bay

Claire Buchanan, Interstate Commission on the Potomac River Basin, Rockville, MD; *Richard Lacouture,* Academy of Natural Sciences, Benedict Estuarine Research Lab, St. Leonard, MD; *Harold Marshall,* Old Dominion University, Norfolk, VA; *Marcia Olson*, NOAA, Chesapeake Bay Office, Annapolis, MD and *Jacqueline Johnson,* Interstate Commission on the Potomac River Basin, Rockville, MD

ABSTRACT: Food for fish, crabs, and oysters in open water habitats comes from plankton, the small plants and animals suspended in water. Indicators such as chlorophyll are calculated from plankton monitoring data, and help us factually answer the question, "How is the Bay doing?" We know that algal blooms damage both the ecology and economy of Chesapeake Bay. Algal blooms are excess phytoplankton production spurred by high nutrient concentrations, that desirable grazer species such as oysters, menhaden, clams, and copepods are unable to consume. Plankton indicators are sensitive to changes in water quality, and they measure the ability of Chesapeake Bay to support living resources. Analysis of plankton indicators from the combined Maryland and Virginia monitoring data suggests the following: as water quality improves, we can expect fewer algal blooms, more zooplankton that directly benefit forage fish, and significant declines in jellyfish and comb jellies, predators on fish larvae and zooplankton and irritants to human swimmers in the Bay. Appropriately productive populations of phytoplankton that benefit zooplankton occur when water clarity is high and nitrogen and phosphorus concentrations are low.

Water quality conditions that do not meet these requirements were found in more than 90% of the samples collected at biomonitoring stations in open water habitats over the past 15 years. This impedes the recovery of a healthy, balanced food web that benefits the living resources we are trying to restore. If water clarity can be sufficiently improved through suspended sediment reductions, less stringent nutrient concentrations will be required to control algal blooms. The data analysis indicate that low salinity waters with secchi depths greater than 0.7 - 0.9 m and high salinity waters with secchi depths greater than 1.45 - 2.15 m will not produce algal blooms, even when nutrient concentrations exceed algal growth requirements several-fold. Larger shellfish and menhaden populations may be needed to control algal blooms and meet the chlorophyll criteria, in addition to sediment and nutrient reductions. Phytoplankton production is not readily passed through the food web to fish when filter-feeding species such as oysters, clams, and menhaden are scarce, and very stringent nutrient and sediment reductions could be necessary to control algal blooms. Monitoring information presently tells us if fluctuations in our forage fish and shellfish populations can be related to changes in plankton food or water quality conditions during critical growing periods, as opposed to over-harvesting or disease. Future monitoring data will tell us if food and habitat conditions are able to support the fisheries species we have worked to restore.

Recommended management actions:
Fisheries and water quality must both be managed in ways that prevent algal blooms and encourage a more efficient transfer of phytoplankton production to fish, crabs, and oysters. This will ultimately increase the food base of recreationally and commercially important living resources. Efforts to reduce suspended sediments must be increased. Poor water clarity caused by suspended sediments is a bigger problem in open waters than previously thought. Plankton monitoring should be supported because adaptive multi-species management approaches will need information on the Bay's ability to support key species as they are restored.

The Herring Run Watershed Association 2000-2001 Water Quality Program

Dan Dillon, Herring Run Watershed Association, Baltimore, MD

ABSTRACT: In 2000 and 2001 over two hundred volunteers clocked five thousand hours as part of the Herring Run Watershed Association's (HRWA) Water Quality Program funded by the National Fish and Wildlife Foundation. Twenty-six sites in the watershed were regularly sampled for eight parameters of stream health. Five other sites were sampled for macroinvertebrate presence--a partnership with Maryland Save Our Streams Project Heartbeat. Habitat assessments based on Maryland Department of Natural Resources formats were made in several catchment areas of the watershed. Partnerships were made with city, county, state and federal officials in areas of public works, health, environment and forestry. Large amounts of data were collected by the. HRWA. The Association's 2000-2001 Water Quality Program was a huge success in terms of volunteer action, data collection and cooperation across boundaries. This session will address the core-role watershed organizations can play as information resources for the entire environmental community and the use of GIS and photo-documentation to educate communities about the watershed and natural environmental issues.

Implications of Scale and Watershed Size for Management Approaches: An Example Relating to Biocriteria

Rich Eskin, Maryland Department of the Environment, Baltimore

ABSTRACT: As Maryland transitioned biocriteria from an assessment tool for environmental management to a tool for regulatory decision-making related to designated use support and impairment, several issues of scale became apparent. Possible scales for decision-making ranged from the 75-m stream sampling segments, to river segments, to 12- or 8-digit watersheds. The implications of each of these scales to management decisions will be discussed.

Evaluation of Stream Impacts from Leaking Infrastructure in the Lower Gwynns Falls Watershed

Gary T. Fisher, US Geological Survey, Baltimore, MD and *William P. Stack*, Baltimore City Water Quality Management Office

ABSTRACT: Gwynns Run and Maidens Choice Run have been identified by Baltimore City as being among its most degraded streams. Leaking water infrastructure in the watersheds is suspected to have significant impacts on water quality of the receiving streams. A study is ongoing to identify sources of contamination and evaluate methodologies for identifying contaminants and possible surrogates. Initial sampling indicates that selected organic compounds are useful as indicators of leaking sanitary sewers, including fecal constituents, human pharmaceuticals, fragrances and insect repellent. Longitudinal variations of stream discharge and water temperature may also be useful in evaluating impacts of leaking infrastructure. Additional synoptic sampling and continuous measurements of discharge and water temperature are planned through at least September 2002, and will focus on identifying interactions among streams, storm-sewer, drinking-water and sanitary-sewer systems.

Nitrogen Fluxes in Urban Riparian Zones

Peter M. Groffman, Institute of Ecosystem Studies, Baltimore Ecosystem Study

ABSTRACT: Riparian zones have been found to function as “sinks” for nitrate (NO3-), the most common groundwater pollutant in the U.S. The vast majority of riparian research, however, has focused on agricultural watersheds. There has been little analysis of riparian zones in urban watersheds, despite the fact that urban areas are important sources of NO3- to N-sensitive coastal waters in many locations. In this study, we evaluated if soil, vegetation and hydrologic factors affected by urbanization reduce the potential for denitrification in urban riparian zones. Denitrification is an important microbial process that converts NO3- to N gases, thus removing them from the ecosystem. We found no difference in denitrification potential between urban and rural riparian sites, with either forested or herbaceous vegetation cover. Urban streams, however, were more incised and had lower water tables in their riparian zones than rural streams. Lower water tables prevent interaction of groundwater-borne NO3- with near surface soils that have the highest denitrification potential. These results suggest that urban hydrologic factors can cause riparian zones to be “hydrologically isolated” from streams and uplands, reducing their NO3- removal function in urban watersheds. This function can only be restored by managing the flow of water from uplands to streams, allowing interaction of NO3- with the biologically active zone of the riparian soil.

About Project WET!

Cindy Grove, Maryland Department of Natural Resources, Annapolis

ABSTRACT: Project WET (Water Education for Teachers) is an international, interdisciplinary water science and education program for students in grades K-12 that is sponsored in part by The Perrier Group. Founded in 1984, Project WET is a program, a curriculum, and a network of coordinators and water educators. It is grounded in the following beliefs:

As water is vital to our daily lives, water management education is crucial for providing future social and economic stability in a healthy environment.

Water is important for all water users (e.g., energy producers, farmers and ranchers, fish and wildlife, manufacturers, recreationists, rural and urban dwellers).

Awareness of and respect for water resources can encourage a personal, lifelong commitment to environmental responsibility and positive community participation.

In each state or province, the program is sponsored by a natural resource agency, university, or museum and is implemented by a Project WET Coordinator. Coordinators train facilitators, who in turn provide workshops for classroom teachers, agency educators, resource managers and others.

Healthy Water, Healthy People is a new water quality education program sponsored by the Hach Scientific Foundation. The Healthy Water, Healthy People program is designed to make water quality concepts understandable and relevant for all students. Healthy later, Healthy People Water Quality Education Stations, sponsored by the Hach Company and The Perrier Group of America, will involve students in hands-on activities that demonstrate the importance of healthy water for healthy people and environments.

Nutrient Discharges from Watersheds Covering a Few Hectares to Hundreds of Square Kilometers

Thomas E. Jordan, Donald E. Weller, and *David L. Correll*, Smithsonian Environmental Research Center, Edgewater, MD

ABSTRACT: By measuring discharges from small watersheds we can distinguish the effects of particular land uses, but can we extrapolate the results to larger watersheds? Using automated samplers, we have measured discharges of water, sediments and nutrients from about 80 watersheds ranging in size from 0.06-900 km2. For Coastal Plain watersheds less than 3 km2, water discharge per km2 often decreases with decreases in area. However, we can predict discharges of large watersheds by modeling the effects of land cover on material concentrations separately from the
effects on water flow, basing flow models on measurements of watersheds >3 km2. Our models successfully predict discharges of nutrients from a 900-km2 watershed, which includes reservoirs, point sources and land in the Coastal Plain and Piedmont. We are working toward scaling up to thousands of km2. We have found that watersheds of a few km2 or thousands of km2 discharge similar proportions (20-30%) of their anthropogenic inputs of N.

Sediment and Scale in the Chesapeake Bay

Michael Langland, U.S. Geological Survey, Lemoyne, PA

ABSTRACT: Basin size (scale) is a critical consideration when describing sediment processes. The integral process of sediment source, transport, storage and delivery will vary considerably depending upon spatial scale and location. This presentation will examine examples of selected sediment processes at scales ranging from the Chesapeake Bay Basin to small farm fields.

Water Quality Information Center

Joseph R. Makuch, Alternative Farming Systems Information Center, National Agricultural Library

ABSTRACT: The Water Quality Information Center at the National Agricultural Library (NAL) is part of the U.S. Department of Agriculture's Agricultural Research Service. As the focal point of NAL's water quality efforts, the center collects, organizes and communicates scientific findings, educational methodologies and public policy issues related to water quality and agriculture. See the center's Web site at www.nal.usda.gov/wqic.

Examining Macroalgae in the Maryland Coastal Bays

Margaret McGinty, Carrie Kennedy, Kara Schwenke, Calvin Jordan, Linda Hanna, Paul Smail, Cathy Wazniak, and Dave Goshorn, Maryland Department of Natural Resources, Annapolis, MD

ABSTRACT: Macroalgae blooms have recently become the focus of monitoring and research efforts in the Maryland Coastal Bays. These blooms are increasing on a global scale in response to nutrient enrichment to shallow coastal waters (Valiela, 1992). Though no historic data exists to ascertain trends in the macroalgae community in the Maryland Bays, anecdotal data suggest that these blooms may be on the increase. There is a concern that if the macroalgae community becomes dominant, it could impact the ecosystem by reducing aquatic habitat quality.

In 1998 and 1999, the Maryland Department of Natural Resources (DNR) with the University of Delaware conducted a study to examine the response of macroalage to a nutrient gradient. The study tested the hypothesis that macroalgae biomass increases in response to increased nutrient loads. Water quality and macroalgae data were gathered over the two-year study period. Examination of the water quality data showed that generally, water quality measurements were similar among the embayments. However, when macroalgae data were examined, there was an apparent difference in species distribution and abundance among embayments. Several of the species observed have been associated with nitrogen enrichment in other areas of the world. These results led DNR to conduct an extensive mapping exercise in the Coastal Bays. To date, over 600 sites in the bays have been sampled in the spring and summer of 2001. These data show the distribution of the prevalent macroalgal species in the Bay, and how their distribution and biomass change between the spring and summer season. These stations will again be sampled this fall and winter. These data will be used to determine the season of peak abundance and lend guidance to developing a baywide monitoring program for macroalgae.

Additionally, DNR, with support from the Maryland Water Monitoring Council, the Maryland Coastal Bays Program, the Assateague Coastal Trust and the Maryland Coastal Zone Management Program will host a workshop this winter to develop a firm understanding of the function and role of macroalgae in shallow coastal ecosystems.

Real-Time Streamflow and Current Ground-Water Levels in Maryland

Wendy McPherson, U.S. Geological Survey, Baltimore, MD

ABSTRACT: U.S. Geological Survey (USGS) water data are available on the web through the National Water Information System (NWISWeb) at http://water.usgs.gov/md/nwis/nwis. The focus of this poster is real-time streamflow and current ground-water levels.

The USGS Maryland-Delaware-District of Columbia (MD-DE-DC) District office measures streamflow at 46 real-time sites in Maryland. Real-time data typically are recorded at 15-60 minute intervals, stored onsite, and then transmitted to USGS offices every 1 to 4 hours, depending on the data relay technique used. Recording and transmission times may be more frequent during critical events. Data from real-time sites are relayed to USGS offices via satellite, telephone, and are available for viewing within minutes of arrival.

Extremes in streamflow, such as flood stage and droughts, are mapped at the WaterWatch website: http://water.usgs.gov/waterwatch/.

In Maryland, ground-water levels are measured monthly for 33 water table wells and 13 artesian or confined aquifer wells. The data are available on the web at: http://md.water.usgs.gov/groundwater/.

These data are used to prepare the monthly water conditions press release for Maryland, Delaware, and District of Columbia that appears on the MD-DE-DC webpage: http://md.water.usgs.gov/

ENHANCED ESTUARINE SHALLOW WATER HABITAT ASSESSMENT

Michael, B.D., *R.E. Magnien, T.M. Trice, T.A. Parham, L.P. Karrh*, Maryland Department of Natural Resources, Annapolis; *W.R. Boynton* and *N.H. Burger*, University of Maryland, Chesapeake Biological Laboratory, Solomons

ABSTRACT: Estuarine monitoring programs have traditionally relied upon discrete (in time and space) monitoring data to conduct both large-scale and site-specific assessments. Some of these assessments have involved monitoring data alone, such as determination of nutrient trends or characterization of water quality problems. Rarely do managers have all of the monitoring information needed to adequately assess problems due to limited resources or limitations in current measurement technologies. In recent evaluations of Chesapeake Bay water quality and habitat monitoring programs relative to emerging management needs, a number of monitoring "gaps" were identified. Two of the principal "gaps" for Chesapeake Bay assessment were the lack of monitoring in shallow water habitats and monitoring of short-term events such as diel sags in dissolved oxygen. The Maryland Department of Natural Resources (DNR) in cooperation with the University of Maryland have piloted innovative spatially and temporally intensive shallow water monitoring techniques over the last several years. These monitoring efforts supplement information derived from the Chesapeake Bay Monitoring Program which utilizes fixed stations at representative locations in the mainstem and tributaries to characterize current conditions and determine long-term trends for a broad suite of physical, chemical and biological variables. The DNR uses statistical and graphical analyses to assess the relationship between long-term tidal tributary monitoring efforts and shallow, near shore spatially and temporally intensive monitoring for use in evaluating water quality criteria and key habitat parameters.

Using Online GIS as a Water Quality Monitoring Tool

Kenneth Miller, Maryland Department of Natural Resources, Annapolis

ABSTRACT: Using Internet-based GIS tools can provide a number of different benefits for measuring and tracking water quality monitoring activities. MERLIN Online (http://www.mdmerlin.net) is meeting several different needs for the Maryland Department of Natural Resources, such as accurately determining station locations and coordinating the efforts of a variety of different monitoring programs. This session will explore how a system like MERLIN Online is being used and how it might be used in the future.

Water Quality, River Flow and Benthos: A Correlation Analysis

Paul Miller, Maryland Department of Natural Resources, Annapolis and *Elgin Perry*, Statistician**,** Huntingtown, MD

ABSTRACT: The Core/Trends non-tidal monitoring network is used to evaluate the effects of management action on water chemistry parameters. Trends in benthic community measures and water chemistry have been used to determine if habitat quality has improved. This study uses coincident measures of water chemistry, stream flow and benthos at 27 stations on Maryland rivers (4^{th} order and larger) to determine the statistical significance of relationships between benthic indices, water chemistry and river flow variables.

Thirteen water quality parameters were sampled monthly since 1986 (CHLA, Cond, DO, NH4, NO23, NO2, NO3, pH, PO4, SO4, TALK, TN and Turb) and 4 sampled monthly since 1976 (TSS, TP, TOC, TKN). The macroinvertebrate community was sampled annually at 27 locations by Surber Sampler or a Fullner modified Hester-Dendy multiplate sampler. Genus level information was used to determine Hilsenhoff Biotic Index (HBI), Shannon-Weiner Diversity Index, TAXA # and % EPT. Daily flow was obtained from the USGS National Water Information System (NWISWeb)

Spearman Rank Correlation was used to determine trends for benthic indices, trends in mean values of water chemistry variables which occurred 120 days prior to the benthic sampling date and trends in total flow, maximum flow, minimum flow and mean flow in the 120 days prior to the benthic sampling date. Correlation analysis was used to test the statistical significance ($P<0.01$) of the relationship between the benthic indices and water chemistry or flow parameters when there were significant trends in these indicators.

TAXA # and Biotic Index correlated with significant water chemistry Trends at 60% of the stations while % EPT showed significant correlation at 40%. Diversity Index showed no significant trends. Trends in water chemistry parameters occurred at a total of 21 stations but could be associated with significant changes in the benthic community at fewer than half of the stations. There were no stations where benthic indices were significant but water chemistry or flow parameters were not and there were 6 stations where none of the indicators had significant trends.

Fish Tissue Mercury Levels in Maryland Streams and Rivers

Paul Miller, Maryland Department of Natural Resources, Annapolis; *Rob Mason* and *Auja Sveinsdottir*, University of Maryland, Chesapeake Biological Laboratory, Solomons

ABSTRACT: Three separate studies of fish tissue mercury concentrations were undertaken to determine the extent to which the contaminant could be detected in individual fish of commercial or recreational importance. Beginning in 1992, selected reservoirs, non-tidal portions of rivers and Chesapeake Bay were sampled by the Academy of Natural Sciences Estuarine Research Center (ANSERC). Several small streams were sampled by the Chesapeake Biological Laboratory (CBL) from 1997-1999 to determine the relationship of methylmercury tissue concentration and stream water chemistry (ANC, pH and DOC); and in 2000, CBL began systematic sampling of Maryland public reservoirs. Mercury accumulation in stream fish tissue appears to be related to size and species. Brook trout and chain pickerel accumulate Hg as they grow larger, sunfishes (redbreast, blue spotted, bluegill) do not. Rates of accumulations of Hg are similar for fish in estuarine and tidal fresh environments when compared to fresh water reservoirs. Fish of the same size in estuarine environments, however, appear to have lower tissue levels when compared to individuals in reservoirs. There is considerable variation in the accumulation rate among largemouth bass in reservoirs. The regression slopes varied from 0-1.4. Stream fish have lower tissue concentration primarily because of their small size, suggesting that the processes controlling Hg bioaccumulation are similar in streams and reservoirs.

Water Quality Status and Trends in Maryland Non-tidal Rivers: 1986-2000

Paul Miller, Maryland Department of Natural Resources, Annapolis

ABSTRACT: Water quality samples from major (fourth order and larger) streams in Maryland have been collected monthly since 1986. Status and trends are determined annually for total nitrogen (TN), total phosphorus (TP) and total suspended solids (TSS) at 54 locations. Stations with the lowest median TN concentrations are found in the western portion of the state and highest median concentrations are associated with stations in agricultural or urban regions. Trends based upon TN concentrations improved at 63% of the stations and became worse at 2%. No significant trends were observed at the remaining stations. Stations whose median TP concentration fell into the lowest 1/3 of the benchmark data (46%) predominated and were found in western Maryland and in the suburban corridor between Washington, D.C. and Baltimore Stations with which fell into the highest 1/3 of the benchmark data set (24%) were distributed, primarily in the central portions of the state. Seventeen percent (17%) of stations showed improving trends in TP concentrations between 1986 and 2000, but, most stations had no significant trend. Median TSS concentrations at each station ranged from 2 mg/L to 16 mg/L. Most stations (48%) had median TSS concentrations in the lower 1/3 of the benchmark data set compared to 24% in the highest 1/3 of the samples. The trend in TSS was significant at only one station on Antietam Creek downstream of Hagerstown where the concentration was increasing.

Impervious Surface Mapping of the Chesapeake Bay Watershed

John Morgan III, Towson University, Towson, MD

ABSTRACT: The Towson University Center for Geographic Information Sciences (CGIS) used remote sensing and Geographic Information System (GIS) technologies to map impervious surfaces in the entire Chesapeake Bay Watershed Area (CBWA) and Maryland's Coastal Bay Watersheds (MCBW). CGIS researchers used an algorithm to classify late winter/early spring 2000 (leaf off) corrected Landsat-7 images. Then digital image processing was performed on a county-by-county basis to map impervious surfaces. An accuracy assessment of the impervious surface maps is currently underway. To map small watersheds accurately, GIS was used to measure the amount of impervious surface. Empirically-derived impervious surface coefficients were developed for various land uses to improve estimates of impervious surfaces derived from satellite imagery. The resultant impervious surfaces map was "clipped" by watershed and county boundaries that were derived from Federal Geographic Data Committee (FGDC) sources. Finally, GIS was used to prepare a map that identified slightly, moderately or severely-impacted watersheds based on percentages of impervious surfaces.

A Chesapeake Bay from Space web site has been developed for accessing processed satellite imagery, derived impervious surface maps, impacted watershed maps and other GIS data. CGIS plans to develop an Internet-based mapping application in the near future. For Towson University's Center for Geographic Information Sciences (CGIS), the tangible results of the impervious surface mapping project include: 1) development of impervious surface maps using Landsat 7 imagery and related data; 2) provision of "local" data on imperviousness to support water quality planning efforts; 3) development of an effort to encourage use of imperviousness as a measurable environmental indicator by state and local government agencies; 4) documentation of the impact of imperviousness at the small watershed level for water quality modeling efforts by regional and state agencies; and 5) increased availability of Landsat 7 data, impervious surface maps and related data.

Trends in Water Chemistry and Temperature Response to Urbanization in Piedmont Streams: Is Scale Important?

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ABSTRACT: Urbanization can have dramatic effects on stream chemistry and temperature. As a result of point and non-point source inputs, significant increases in conductivity, nutrients, and BOD are common. Far less is known about temperature responses to urbanization. In addition, there is little published information on whether chemical and temperature responses to urbanization are similar at different spatial scales. We measured base flow water chemistry (conductivity, pH, dissolved oxygen, nitrate/nitrite, soluble reactive phosphorus and turbidity) monthly in 30 streams along a gradient of urbanization (0-60%) in the Etowah River Basin, near Atlanta, Georgia. In addition, we recorded temperature continuously in each stream. The streams were from three different catchment size categories: 15, 50, and 100 km^2. This selection corresponded to an approximate doubling of average bankfull discharge. Conductivity, nutrient concentrations and turbidity increased with urban land cover. Dissolved oxygen decreased and pH exhibited no significant response. Responses were independent of catchment size. There was generally little response of temperature to urbanization. Mean daily summer temperatures were slightly higher in urban catchments. But there was little response in daily temperature fluctuations or max. and min. temperatures. Clearly, urbanization continues to be associated with dramatic changes in stream chemistry. However, this effect does not appear to be influenced by spatial scale: similar levels of urbanization resulted in similar responses in all three catchment sizes. In addition, temperature appears relatively uninfluenced by urbanization in this region. This may be a function of the regional hydrology and riparian coverage associated with urbanization.

Biological Assessment of the Little Patuxent River, Cattail Creek and Brighton Dam Watersheds, Howard County, Maryland

Kristen L. Pavlik and *James B. Stribling*, Tetra Tech, Inc., Owings Mills, MD; *Howard Saltzman* and *Angela Morales*, Howard County Department of Public Works, Columbia, MD

ABSTRACT: The Howard County Department of Public Works (DPW) Stormwater Management Division (SWMD) recently initiated biological monitoring for its streams and wadeable rivers on an annual, rotating basin cycle. The primary goal of this biological monitoring program is to assess the current status of stream biological resources (including benthic macroinvertebrates, fish, and physical habitat quality) of Howard County streams and watersheds and to establish a baseline for comparing future assessments. The County has identified the need to address more specific questions at three geographic scales and on which to base the initial design: stream-specific, watershed wide; and, after the five-year sampling rotation is complete, county-wide.

In an effort to work with the State's environmental reporting requirements, the data collected in this effort will be comparable to that collected by the Maryland Department of Natural Resources (DNR) Maryland Biological Stream Survey (MBSS), providing a higher density of sampling locations in the County, and an increased potential for problem identification. To obtain a larger number of samples, and concentrate on a watershed already identified for restoration activities (Little Patuxent River watershed), the Watershed Restoration Division (WRD) of DNR assisted the County in fieldwork, laboratory processing and taxonomic identification. Results will be related to specific programmatic activities, such as best management practice (BMP) siting and installation, stormwater permits and protection/restoration activities. Members of the community will also be able to access the yearly report via the County website, as well as brochures that highlight specific watersheds.

Sampling methods were identical to those used by the MBSS: benthic macroinvertebrates sampled using a D-frame net in multiple habitats (20-jab method), visual-based assessment of physical habitat quality, and selected field chemistry. In addition, substrate particle size distribution and stream channel cross sectional area were evaluated for approximately 50% of the sites. Fish were also sampled from half of the sites. Biological condition scores were derived using the MBSS Benthic Index of Biological Integrity (B-IBI).

The Urban Reference Index:
An Index of Biotic Integrity for Urban Watersheds

Michael W. Powell, Jeffrey Boltz, David Mayhew, Richard Connelly, EA Engineering, Science, and Technology, Sparks, MD; and *Bill Stack,* Baltimore Department of Public Works, Baltimore

ABSTRACT: EA Engineering, Science, and Technology is assisting the City of Baltimore in revising and enhancing biomonitoring programs for the City's streams. As part of this process, a special measure of biological condition was developed called the Urban Reference Index. The Urban Reference Index is intended to serve as a diagnostic tool that is based upon the Index of Biotic Integrity (IBI) developed by the Department of Natural Resources Maryland Biological Stream Survey (MBSS) for fish and benthic invertebrates. The IBI is a standard biomonitoring protocol created by combining metrics for species composition, trophic status, and abundance of either fish or benthic communities. The Urban Reference Index is the IBI score deemed to be near the best achievable in an urban environment, and is calculated as the 90th percentile of IBI scores from Maryland urban watersheds.

The Urban Reference Index was used as a guideline to design fish and benthic biomonitoring programs for Gwynns Falls, Jones Falls and Herring Run watersheds in Baltimore County. A linear variance component model was used to explore the effects of various sampling designs on the power to characterize watershed status relative to the Urban Reference Index and to detect temporal trend. The variance component model includes the effects of natural spatial and temporal variability and the inherent variability in the sampling process which all affect the ability to describe ecological status and trend. The optimal sampling designs were those that employed annual sampling of randomly selected sites within each watershed along with a small number of fixed sampling locations.

Influence of Watershed Morphology and Sediment Biogeochemistry on Nitrate Fluxes to Streams

Karen Prestegaard, University of Maryland, College Park

ABSTRACT: Nitrate concentrations in stream waters are often not simple functions of either land use or fertilizer application rates. The hydrological processes that deliver water to streams and the geochemical characteristics of the substrate that the water passes through both influence nitrate delivery rates. We have conducted field studies to define the spatial and temporal variations in hydrological processes and their influence on nitrate fluxes in a number of small watersheds. Our goal in these studies is to define relationships among hydrological processes, nitrate fluxes and the physical characteristics of watersheds and streams that can be used to extend results of these small watershed studies to larger watersheds.

Balancing the Scale: Providing Small Watershed Evaluations to Assist WRAS Planner's Targeting

Niles L. Primrose, Kevin R. Coyne and *John L. McCoy*, Maryland Department of Natural Resources, Annapolis, MD

ABSTRACT: In the beginning, there was the Chesapeake Bay Program and big water monitoring sat heavily on one end of the scale, with little weight in the small watersheds at the other end. Then there was tributary monitoring and state wide assessments that began to add weight to the small watershed end of the scale. Now, through the WRAS (Watershed Restoration Action Strategy) process, the scale is coming into balance by taking a close quantitative look at the places where the streams start. To assist in this process, DNR's Chesapeake and Coastal Watershed Services, Watershed Restoration Division, is providing timely quantitative data on WRAS watershed nutrient concentrations, instantaneous loads, and yields, and data on macroinvertebrate and fish communities (MBSS compatible), integrated with information gathered through Stream Corridor Assessments. Surface water samples are collected at baseflow during late winter to early spring to coincide with high groundwater recharge. Stream discharge measurements and insitu readings of temperature, pH, dissolved oxygen, and conductivity are taken at the time and location of grab sample collection. Surface water grab samples are filtered and analyzed for dissolved constituents (NO_{23}, PO_4). Macroinvertebrate and fish samples are collected during appropriate index periods. Stream Corridor Assessment data is provided by Chesapeake and Coastal Watershed Services, Watershed Assessment and Targeting. The end products we provide include maps with subwatersheds delineated showing nutrient concentrations, instantaneous loads and yields, and biological indices overlain with Stream Corridor Assessment data points. This display provides an easy method of finding associations between chemical, biological, and physical data in a watershed. This fine scale of analysis, coupled with historic data and land use information, provides an excellent base from which watershed planners can begin the task of documenting and prioritizing areas for restoration and protection.

Application and Extension of TOPMODEL Concepts to Hydrochemical Processes in Small Watersheds

Jeff P. Raffensperger, US Geological Survey, Baltimore, MD

ABSTRACT: TOPMODEL is a semi-distributed, physically based rainfall-runoff model that has been widely applied to examine processes that occur in small watersheds. Its advantages lie in its ability to simulate various contributions to the storm hydrograph (baseflow, saturation- and infiltration-excess overland flow) that match field observations, but with a parsimonious parameter set and relatively little calibration. The TOPMODEL concept(s) are easily programmed and have been programmed in a number of different computer languages and formats, and the procedural models that have resulted are typically not computationally intensive. As one example, Scanlon and others modified TOPMODEL to explicitly include subsurface stormflow (or interflow), in order to match observations of transient, perched water tables in the shallow subsurface at the South Fork Brokenback Run catchment in Shenandoah National Park, VA. The macroporous subsurface stormflow zone provides a hydrological pathway for rapid runoff generation apart from the underlying groundwater zone, a conceptualization supported by the two-storage system exhibited by hydrograph recession analysis. In this modification of TOPMODEL, generalized topographic index theory is applied to the subsurface stormflow zone to account for logarithmic stormflow recessions, indicative of linearly decreasing transmissivity with depth. Vertical drainage to the groundwater zone is required and both subsurface reservoirs are considered to contribute to surface saturation. In addition, simulated groundwater, subsurface stormflow and overland flow components of discharge were used with measured stream water and lysimeter concentrations of dissolved silica to investigate the hydrochemical behavior of the catchment. Concentrations in baseflow, taken to be a reflection of groundwater, vary with discharge, an observation in conflict with the typical assumption of constant concentration used in end-member mixing analyses. This observed flow dependence was modeled by considering the concentration in groundwater to be related to the saturation deficit in this zone. A positive correlation between the average groundwater saturation deficit and baseflow dissolved silica concentrations is consistent with batch experiments and petrographic analysis of regolith core samples, which both indicate an increase in silica available for dissolution with depth in the groundwater zone. In the absence of subsurface stormflow zone sampling during rainfall events, a constant concentration was assumed for this zone. Concentration-discharge (C-Q) paths in the stream were used to evaluate the modeled stream silica concentrations. An inconsistency in the direction of the modeled C-Q rotations suggests that the stormflow zone dissolved silica concentration may also vary with time, due to the "flushing" of high concentration, pre-event soil water on the rising limb of the storm hydrograph. For this catchment in Virginia, the assumption of a constant concentration for stormflow, as well as for baseflow, appears to be invalid.

Integration of State and County Stream Monitoring Programs

Nancy Roth, Jon Volstad, Ginny Mercurio, and *Mark Southerland*, Versar, Inc., Columbia, MD; *Ron Klauda* and *Paul Kazyak*, Maryland Department of Natural Resources, Annapolis; *Keith Van Ness*, Montgomery County Department of Environmental Protection, Rockville, MD; and *Wayne Davis*, U.S. Environmental Protection Agency, Ft. Meade, MD

ABSTRACT: While the Maryland Biological Stream Survey (MBSS) monitors streams statewide, a number of Maryland counties also assess their streams, usually at a finer level of spatial resolution. Integration of state and countyl efforts can improve the accuracy of stream condition estimates in local areas, reduce duplication of effort, and help agencies provide consistent and reliable statements to the public. Using the MBSS and Montgomery County Department of Environmental Protection programs as a case study, we investigated several key issues that must be resolved for effective integration: (1) differences in survey designs, (2) comparability of field and laboratory sampling protocols, (3) different indicators for rating stream condition, and (4) complexity and costs of integrated data analysis. Individual program objectives have historically led to different approaches by different agencies, so integration requires extensive information beyond the basic monitoring data. Information that must be obtained from both programs includes GIS files of streams, watershed boundaries, and geographic strata (used in site selection and indicator development); techniques for training field personnel; field sampling manuals and field data sheets; and procedures for calculating Indices of Biotic Integrity (IBIs).

Within the Seneca Creek pilot watershed, GIS analyses of the 1:24,000-scale map used by Montgomery County and the 1:100,000-scale map used by the MBSS revealed a large overlap in streams (202 stream miles), although a substantial number of additional streams were only found on the 1:24,000-scale map (120 stream miles). Field sampling protocols of the two programs are similar for fish, and no significant differences were found between fish IBI scores based on two versus three electrofishing passes. Preliminary analysis suggested that differences in benthic sampling and laboratory protocols (use of D-net vs. kick net, 100- vs. 200-organism subsampling, genus vs. family identification of chironomids) may affect benthic IBIs and resultant stream condition ratings. A field comparison study was designed and is underway to further investigate these factors. Site selection procedures vary between
the two programs, although both employ random sampling to support watershed estimates. Accounting for these differences, an analytical approach for calculating integrated estimates of stream condition was developed. In the Seneca Creek example, the relative standard error (RSE) for the integrated mean fish IBI was 4.9%, as compared to RSEs of 8.1 % and 6.1% for the mean IBIs based on MBSS and Montgomery, respectively. With the support of USEPA, these results and future integration of stream data by MBSS and Montgomery County provide a model example for integrating other county, local and volunteer monitoring efforts.

Method Performance Characteristics and the Merging of Biological Assessment Data Sets

James B. Stribling, Tetra Tech, Inc., Owings Mills, MD

ABSTRACT: "Standard" protocols for performing biological assessments are actually a series of methods that, when performed together, can provide high quality data and estimates of biological condition. For example, assessment activities that specify rapid bioassessment protocols (RBP) use various specific methods for selecting sampling locations, field sampling, sample sorting, taxonomic identifications, data entry and data management, data analysis and interpretation of conditions. Different approaches for accomplishing any of these steps may render two data sets or programs incomparable. Even if different monitoring/assessments programs purportedly use the same methods, each program may be unable to document performance characteristics. This makes combining data sets problematic, since there may be no way to evaluate uncertainty. Performance characteristics include concepts and calculations such as, for example, precision, accuracy, bias, representativeness and completeness. In this paper, I describe development of one performance characteristic; i. e., percent taxonomic disagreement (PTD), a quantification of the precision associated with taxonomic identifications. I also illustrate the potential use of PTD as a QA/QC "control limit" for determining the taxonomic quality of a data set, and its acceptability for direct comparison.

Relating In-stream Biological Condition to BMP Activities in Streams and Watersheds

James B. Stribling and *Erik W. Leppo*, Tetra Tech, Inc; *James D. Cummins*, Interstate Commission on the Potomac River Basin; *John Galli*, Metropolitan Washington Council of Governments; *Sharon Meigs, Larry Coffman* and *Mow-Soung Cheng*, Prince Georges Department of Environmental Resources

ABSTRACT: Assessment of the effectiveness of any environmental management activity is dependent on stated (or implied) goals. Use of biological indicators to evaluate the success of stressor-control features in enhancing or protecting overall stream or watershed conditions requires that some numeric decision threshold be developed. The indicators are thus interpreted with some understanding of their expected status in the absence of stressors. The stated goal(s) of stormwater (SW) management/best management practices (BMPs) such as detention/retention ponds, riparian revegetation, bank stabilization, grade control structures and others is the removal or buffering of stressors that cause receiving streams to be ecologically impaired. This paper presents findings from two case studies where a "BMP-assemblage" was evaluated without the benefit of calibrated biological reference conditions, and another case study where SW retention ponds, in isolation, were evaluated with calibrated reference conditions.

Revised March 2001

Maryland Water Monitoring Council

BYLAWS

Established by the Department of Natural Resources in 1996 in response to the needs identified by the State's water monitoring community, the Maryland Water Monitoring Council (MWMC) seeks to foster cooperation among groups and individuals involved in all types of water monitoring activities. The MWMC offers a platform where issues related to physical, chemical, and biological monitoring, and those land use factors affecting aquatic habitat quality and quantity can be discussed and evaluated in an atmosphere that promotes a better understanding of Maryland's water resources. The MWMC works closely with the National Water Quality Monitoring Council and other States as strategies for improving water monitoring throughout the United States are developed.

Article One
Name

The name of this organization shall be the Maryland Water Monitoring Council, hereinafter referred to in these bylaws as the Council

Article Two
Purpose

The Council will serve as a statewide collaborative body to help achieve effective collection, interpretation, and dissemination of environmental data related to issues, policies, and resource management objectives involving water monitoring. The Council shall address the full range of aquatic resources, including ground and surface waters, freshwater, estuarine, and marine environments, and associated watershed resources in Maryland.

Article Three
Membership

3.1 General membership in the Council will be open to individuals from agencies, organizations and groups with responsibility for, or participation in, water monitoring activities.

Article Four
Meetings of Members

4.1 Annual Meeting. An annual meeting of the Council shall be held at such time and place as shall be determined by the Board of Directors.

4.2 Special Meetings. Special meetings of the Council may be called by the Board of Directors.

Article Five
Board of Directors

5.1 General Powers. All powers of the Council shall be vested in a Board of

Directors, hereinafter referred to in the bylaws as the Board. The Board shall manage the affairs of the Council.

5.2 Number of Directors. The Board shall consist of 21 individuals representing the following categories:

State Agencies (4 representatives - at least one each from the Department of Natural Resources and Department of the Environment)
Local Agencies (4 representatives)
Federal Agencies (2 representatives)
Volunteer Groups-Environmental Organizations (2 representatives - one of which has statewide affiliation)
Academia (2 representatives)
Intergovernmental organizations (1 representative)
Consultants and Industry (2 representatives)
At-large (4 representatives)

5.3 Terms of Office. Directors shall serve for a term of three years, the terms of no more than one-third of the Board's members shall expire in any given year to allow for stability and continuity in leadership. The terms of office shall begin immediately following the effective date of appointment. [Directors shall serve no more than two consecutive terms, but can be reappointed following one year off-board.]

5.4 Manner of Selection. Board members of the Council shall be appointed by the Secretary of Natural Resources. Nominees for appointment to the Board shall be provided to the Secretary by the Board.

5.5 Alternates. Directors may designate alternates to represent them in their absence.

5.6 Vacancies. Any vacancy occurring on the Board will be filled by appointment by the Secretary of Natural Resources to serve out the remainder of the term of the vacating Director. The replacement Director shall represent the category represented by the leaving Director. The name of a nominee to replace a Director will be chosen by an affirmative vote of the majority of the Directors remaining in office.

5.7 Resignation; Removal. Any director may resign from the Board at any time by giving written notice thereof to the Chair and to the Secretary of Natural Resources. Failure of a member or the designated alternate to participate in more than three consecutive meetings of the Board may constitute grounds for requesting the Secretary of Natural Resources to replace the member.

Article Six
Officers

6.1 Titles. The officers of the Council shall be a Chair, a Vice-chair, a Treasurer, and any other officers as may from time to time be prescribed by the Board.

6.2 Election and Term. All officers of the Council shall be elected by a majority vote. These officers shall be elected from among the members of the Board and shall hold office until the next annual meeting of the Council, subject to removal or resignation prior thereto. Officers shall serve no more than two consecutive terms.

6.3 Resignation, Removal and Vacancy. Any officer may resign from office at any time by giving written notice to the Board or its Chair. Any officer may be removed, for good cause shown, by a majority vote of the full Board. Any vacancy occurring in an office by reason of resignation, removal, or the creation of a new office may be filled for the unexpired term thereof by

a majority vote of the full Board.

6.4 Chair. The Chair shall serve as chairperson of the Board of Directors and shall preside at all meetings thereof. The Chair may enter into all contracts and agreements in the name of the Council, subject to such limitations as the Board may prescribe by resolution.

6.5 Vice-chair. The Vice-chair shall exercise the powers of the Chair in the event of the Chair's absence or inability to perform. The Vice-chair shall also have such powers and duties as may be prescribed by the Board or the Chair.

6.6 Treasurer. The Treasurer shall have custody of all funds and securities belonging to the Council and shall receive, deposit, or disburse the same under the direction of the Board. The Board may appoint a custodian or depository for any such funds or securities. The Treasurer shall be a member of the Finance Committee and perform all other duties incident to the office of Treasurer.

6.7 Executive Secretary. The Department of Natural Resources shall provide staff support to serve the Council in the role of Executive Secretary. The Executive Secretary shall be an ex-officio member of the Board, shall keep accurate records of all meetings of the Board and perform other duties incident to the office of Secretary.

Article Seven
Meetings of the Board

7.1 Annual Meeting. The Board shall hold a meeting for the purpose of annually electing officers and transacting such other business as may properly be brought before the meeting.

7.2 Regular Meetings. The time and place of all regular meetings of the Board shall be as designated by a majority of the Board in consultation with the Chair.

7.3 Special Meetings. Special meetings of the Board shall be called by the Chair or upon request of a majority of the Board.

7.4 Quorum and Voting. A majority of the members of the Board shall constitute a quorum.

7.5 Action Without a Meeting. Any action required or permitted to be taken at any meeting of the Board may be taken without a meeting if consent in writing or by electronic communications, setting forth the action so taken, shall be obtained by a majority of the members of the Board.

Article Eight
Committees of the Board

8.1 Committees. The Board shall have the power to establish and dissolve standing and ad hoc committees. Committee chairs shall be appointed by the Board. Terms of service are not time limited. Committee Chairs shall have the authority to establish ad hoc groups as necessary to fulfill their charge.

8.2 Standing Committees. The Council has the following standing committees:

a)Annual Meeting Committee. This group will organize the Annual Meeting with contribution

from each of the standing committees and workgroups.

b)Programmatic Coordination Committee. This group will facilitate the coordination and collaboration of water monitoring programs within the State of Maryland, and identify next steps to establish a clearinghouse to facilitate the exchange of information on water monitoring programs in the state.

c)Environmental Indicators Committee. This group will develop recommendations on which environmental indicators are useful and relevant to various management objectives and public concerns. The indicators that are recommended will be appropriate for assessing water resources by ecological and physiographic regions of Maryland.

d)Data Management Committee. This group will explore all existing data management procedures employed in Maryland and develop recommended protocols for data management and quality assurance.

e)Assessment & Monitoring Committee. This group will promote the collection of high quality and comparable water monitoring data, the use of appropriate analytical procedures to prepare meaningful assessments of water quality conditions, and the presentation of understandable findings in technical and non-technical formats.

f)Nominating Committee. The Chair of the Nominating Committee shall be a Board Member. The primary responsibility of this committee shall be to evaluate potential Board members. Based upon recommendations from this committee, the Board will forward the names of members to the Secretary of Natural Resources for appointment to the Board.

g)Finance Committee. The Chair of the Finance Committee shall be a Board Member. The Committee shall keep the financial status of the Council under continuous review and shall report at each Board meeting. At least one month prior to the Annual Meeting of the Council, the Finance Committee shall prepare, for presentation, a financial statement which summarizes the financial operations of the Council for the fiscal year immediately preceding and which includes income and expenses in detail and a balance sheet.

Article Nine
Finance

9.1 Fiscal Year. The fiscal year of the Council shall be as determined by the Board by appropriate resolution and may be changed from time to time by the Board, subject to the provisions of applicable federal and state laws.

9.2 Checks. All checks, drafts, or orders for the payment of money shall be signed by such Council members as the Board shall from time to time designate.

Article Ten
Amendments

These bylaws may be amended, repealed, or modified by a majority vote of the Board. Notice of the proposed amendment, repeal, or modification shall be included in the notice of the meeting at which the proposal is to be considered.

In Witness Whereof, the undersigned Chairperson of the Maryland Water Monitoring Council hereby certifies that the above is a true and correct copy of the bylaws of the Council duly

approved by its Board of Directors on _____,
20_____.

_____
Chairperson of the Board of Directors

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Maryland Water Monitoring Council

1 January 2001

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